Laboratory: ALS-Cincinnati

Matrix	Air
Analytical Group	Gravimetric, Particulates as PM-10
Analytical Method / SOP Reference	40CFR50, IH-002
Analytical Organization	ALS – Cincinnati, OH

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Sample Duplicate	One per matrix per analytical method for each batch of at most 10 samples.	Relative Percent Difference must fall within control limits established by QA Officer.	Re-weigh duplicate for confirmation. Notify lab QA Manager and Section Manager of additional measures to be taken.	Analyst Section Manager		

Matrix	Air
Analytical Group	Inorganics, Metals
Analytical Method / SOP Reference	EPA 6010B, IO-3.4, IH-006, IH-7300
Analytical Organization	ALS – Cincinnati, OH

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Equip blank	NA					
Matrix Spike/Duplicate MS/MSD	NA					
LCS	Each group of 20 or less prior or analysis of samples.	Per Method and Lab SOP	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Section Manager	Accuracy	QC acceptance criteria as specified by Lab SOP or QSM
Method Blank	Each group of 20 or less prior or analysis of samples.	No analytes detected ≥ LOQ as shown in Worksheet #15.	Correct problem, then re-prep and reanalyze the MB and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient material is available.	Analyst Section Manager	Sensitivity	No analytes detected ≥ LOQ as shown in Worksheet #15.

Worksheet #29—Project Documents and Records

Sample Collection Documents and Records	Onsite Analysis Documents and Records	Offsite Analysis Documents and Records	Data Assessment Documents and Records	Other
Field notes Electronic Records Scribe database Chain-of-custody records Air bills Custody seals Telephone logs	Sample receipt, custody, and tracking records Equipment calibration logs Equipment maintenance, testing, and inspection logs Corrective action forms Reported field sample and XRF results Air monitoring logs Telephone logs	Sample receipt, custody, and tracking records Narrative Standard traceability logs Equipment calibration logs Sample preparation logs Run logs Equipment maintenance, testing, and inspection logs Corrective action forms Reported field sample results Reported results for standards, QC checks, and QC samples Instrument printout (raw data) for field samples, standards, QC checks, and QC samples Data package completeness checklists Extraction/cleanup records Raw data (stored electronically) QA review records	Data verification/ validation reports Corrective action forms	Project database for analytical and field data Health and safety briefing information Staff health and safety records

The laboratory data package will be organized such that the analytical results are reported on a per analytical batch basis, unless otherwise specified. In addition to the summary data deliverable, a full- supporting raw data deliverable package is required from the laboratory. All data will be provided electronically as a PDF file. Parsons will provide data copies to EPA.

An EDD is also required for all data. The laboratory will provide Parsons with an EDD in an electronic format that is compatible for uploading into Scribe. The data will undergo QA reviews prior to being loaded to the project database. Delivery time for data from the laboratory will vary based on project-specific data use.

29.1 Sample Custody and Tracking Program

The EPA Scribe program will be used for field documentation and generation of chains of custody. Refer to EPA Office of Solid Waste and Emergency Response 9200.2-147, EPA 540-R-014-013 Contract Laboratory Program Guidance for Field Samplers, dated October 2014.

29.2 Project-specific Data Deliverables

Analytical data will be exported into a format consistent with the EDD format specified by EPA Region 5. Data will be submitted to EPA Region 5 in accordance with the requirements located here: https://www.epa.gov/superfund/region-5-superfund-electronic-data-submission.

Documentation and reports specified in this QAPP will be retained in Adobe PDF format.

Worksheets #31, #32, and #33—Assessments and Corrective Action

Assessments:

Assessment Type	Responsible Party & Organization	Number or Frequency	Estimated Dates	Assessment Deliverable	Deliverable due date
Data Review and Verification	Sandra de las Fuentes Project Chemist/Parsons Chad Whelton Laboratory QAO/ALS	All data packages	TBD	Email of deficiencies	After arrival of data from the laboratory and during data verification activities
Sample Management and Tracking	Keith Thompson Exterior Sampling Manager/Parsons Florin Savin Interior Sampling Manager/Parsons Tony Doll and Morgan Todd Disposal Stock Pile Sampling Manager/Parsons	Daily	TBD	Daily Report	Daily during sampling field activities
Data Validation	Sandra de las Fuentes Project Chemist/Parsons	One review after all lab data are received	TBD	Data Validation report	21 business days after receipt of validated data
Data Quality Evaluation	Sandra de las Fuentes Project Chemist/Parsons	One report after all data are validated	TBD	Data Quality Evaluation report	45 business days after project completion

Corrective Action:

Assessment Type	Responsibility for responding to assessment findings	Assessment Response Documentation	Timeframe for Response	Responsibility for Implementing Corrective Action	Responsible for monitoring Corrective Action implementation
Electronic data capture from XRF, PQ100 Ambient Air Particulate Sampler, DUSTTRAK	Keith Thompson Exterior Sampling Manager/Parsons Florin Savin Interior Sampling Manager/Parsons Tony Doll and Morgan Todd Disposal Stock Pile Sampling Manager/Parsons	Field notes/email as required	As soon as notification of corrective action is received	Keith Thompson Exterior Sampling Manager/Parsons Florin Savin Interior Sampling Manager/Parsons Tony Doll and Morgan Todd Disposal Stock Pile Sampling Manager/Parsons	Andrew Hands Data Manager/Parsons
Data review and verification	Sandra de las Fuentes Project Chemist/Parsons Chad Whelton Laboratory QAO/ALS	Corrective action reports and/or updated case narratives and corrected data submissions	3 to 5 business days	Chad Whelton Laboratory QAO/ALS	Sandra de las Fuentes Project Chemist/Parsons

Worksheet #34—Data Verificationand Validation Inputs

To confirm that scientifically sound data of known and documented quality are used in making environmental decisions, the following three-step data review will be performed. Step I (verification) will confirm that all specified activities involved in collecting and analyzing samples have been completed and documented and that the necessary records (objective evidence) are available to proceed to data validation. Step II (validation) will assess whether the sampling and analytical processes comply with the contract-specific and the QAPP-specific requirements. Step III (usability assessment) will determine whether the resulting data are suitable as a basis for the decision being made. Worksheets #34 to #37 describe the processes to be followed. Worksheet #34 establishes the procedures that will be followed to verify project data including, but not limited to, sampling documents and analytical data package. The items subject to verification and validation are listed in the following table.

Item	Description	Verification (completeness)	Validation (conformance to specifications)
Planning Documents/Records			
1	Approved QAPP	X	
2	SOPs	X	
3	Laboratory SOPs	X	
Field Records			
4	Field logbooks	X	X
5	Scribe Database	X	X
6	Chain-of-custody forms	X	X
7	Equipment Calibration forms	X	X
Analytical Data Package			
8	Cover sheet (laboratory identifying information)	X	X
9	Case narrative	X	X
10	Internal laboratory chain-of-custody	X	X
11	Sample receipt records	X	X
12	Sample chronology (that is, dates and times of receipt, preparation, and analysis)	X	X
13	RL/MDL establishment and verification	X	X
14	Standards traceability	X	X
15	Instrument calibration records	X	X
16	Definition of laboratory qualifiers	X	X
17	Results reporting forms	X	X
18	QC sample results	X	X
19	Corrective action reports	X	X
20	Electronic data deliverable	X	X

Worksheet #35—Data Verification Procedures

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Field Notes and Data Sheets	Verify that records are present and complete for each day of field activities. Verify that all planned samples were collected and that sample collection locations are documented. Verify that meteorological data were provided for each day of field activities. Verify that changes/exceptions are documented and were reported in accordance with requirements.	Internal	Keith Thompson Exterior Sampling Manager/Parsons Florin Savin Interior Sampling Manager/Parsons Tony Doll and Morgan Todd Disposal Stock Pile Sampling Manager/Parsons
Chain-of-Custody and Shipping Forms	Verify the completeness of chain-of-custody records. Examine entries for consistency with the field logbook and sample processing log. Check that appropriate methods and sample preservation have been recorded. Verify that the required volume of sample has been collected and that sufficient sample volume is available for QC samples (for example, MS/MSD). Verify that all required signatures and dates are present. Check for transcription errors.	Internal/External	Keith Thompson Exterior Sampling Manager/Parsons Florin Savin Interior Sampling Manager/Parsons Tony Doll and Morgan Todd Disposal Stock Pile Sampling Manager/Parsons Chad Whelton/ALS
Laboratory Data	Verify that the laboratory deliverable contains all records specified in the QAPP. Check sample receipt records to ensure sample condition upon receipt was noted, and any missing/broken sample containers were noted and reported according to plan. Compare the data package with the chains of custody to verify that results were provided for all collected samples. Review the narrative for descriptions of QC exceptions. Check for evidence that any required notifications were provided to project personnel as specified in the QAPP. Verify that necessary signatures and dates are present.	Internal	Chad Whelton/ALS Sandra de las Fuentes Project Chemist/Parsons

Worksheet #36—Data Validation Procedures

Matrix	Analytical Group	Required Deliverable	Validation Percentage	Validation Criteria	Data Validator (title and organizational affiliation)
Soil, Air and Interior Dust Analytical Results	All analytical groups besides geotechnical parameters	Level III Data Report	100% Level II validation	Manual Stage 4[a] validation per EPA National Functional Guidelines, laboratory SOPs, and QAPP criteria	Sandra de las Fuentes, Project Chemist/ Parsons
Soil, Air and Interior Dust Field Results	Real-time air monitoring, XRF results	EDD compatible for uploading into Scribe	100% Level II validation for all required data elements	Refer to Scribe for relevant requirements for Superfund program	Andrew Hands Data Manager/ Parsons

[a]Stage 4 per, "Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use" (Office of Solid Waste and Emergency Response No. 9200.1-85, EPA 540-R-08-005, January 13, 2009)

36.1 Data Verification/Validation Scope Overview

Parsons will perform a Stage 4 data validation in accordance with the "Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use" (Office of Solid Waste and Emergency Response No. 9200.1-85, EPA 540-R-08-005, January 13, 2009), the site-specific QAPP, and laboratory SOPs on 100 percent of the laboratory-generated data from the subcontracted laboratories. EPA Functional Guidelines will be used as guidance for this data validation.

Parsons will review the data validation reports against the data quality objectives to determine whether the data are acceptable. Additionally, a 10 percent comparison between the validated results and EDD will be performed to ensure comparability.

36.2 Field Data Review

Field-generated information may include field logbooks, sample chain-of-custody forms, shipping documents, sampling observations, sample labels, and other miscellaneous field observations. All field measurements and or field log information will be entered into field logbooks and reviewed daily by the field quality manager or designee. The designee may be a qualified field geologist, engineer, environmental scientist, and/or technician.

36.3 Laboratory Data Review Requirements

All analytical data generated by the laboratory will be verified before submittal to the CH2M project chemist. The internal data review process, which is multi-tiered, will include all aspects of data generation, reduction, and QC assessment. In each laboratory analytical section, the analyst performing the tests shall review 100 percent of the definitive data. After the analyst's review has been completed, 100 percent of the data will be reviewed

independently by a senior analyst or by the supervisor of the respective analytical section using the same criteria.

Elements for review or verification at each level must include, but not be restricted to, the following:

- Sample receipt procedures and conditions
- Sample preparation
- Appropriate SOPs and analytical methodologies
- Accuracy and completeness of analytical results
- Correct interpretation of all raw data, including all manual integrations
- Appropriate application of QC samples and compliance with established control limits
- Documentation completeness (for example, all anomalies in the preparation and analysis have been identified, appropriate corrective actions have been taken and documented in the case narrative[s], associated data have been appropriately qualified, and anomaly forms are complete)
- Accuracy and completeness of data deliverables (electronic)

36.4 Laboratory Data Evaluation

The calibration, QC, corrective actions, and flagging requirements for definitive data are shown in Worksheets 12, 15, 24, and 28. The laboratory may apply data qualifiers based on its review or add a note in the laboratory case narrative. The definitions of any data qualifiers applied by the laboratory must be defined in the case narrative. The data qualifiers are reviewed by the supervisor of the respective analytical sections after the first- and second-level reviews of the laboratory data have been performed.

36.5 Data Review Guidelines

The laboratory assessment of the data quality will be reviewed for completeness and accuracy. Data review will be done manually and will include, but is not limited to, the following:

- Sampling documentation (such as the chain-of-custody form)
- Preservation summary and technical holding times
- Presence of all analyses and analytes requested
- Use of the required sample preparation and analysis procedures
- The method detection and reporting limits will be evaluated against the project requirements
- The correctness of the concentration units
- Case narrative

36.6 Data Verification/Validation Guidelines

The data verification process builds on data review. Project data will be reviewed and verified as part of the data assessment for this project. The review will be performed on an analytical batch basis by assessing QC samples and associated field sample results. Data verification guidelines have been developed in accordance with the method requirements, professional judgment, and general EPA national functional guidelines requirements.

Summary data review and verification will be performed as follows:

- Chain-of-custody documentation
- Holding time
- QC sample frequencies
- Digestion blanks
- Digestion blank spike
- LCS spike recoveries
- MS/MSD (if applicable)
- Initial and continuing calibration information
- Field duplicate precision (if applicable)
- Case narrative review and other method-specific criteria

Data qualifiers, as well as the reason for each qualifier, are entered into an electronic database and made available to the data users. A final qualifier is applied to the data by the Parsons project chemist after evaluating all qualifiers and selecting the most conservative of the verification qualifiers.

If during the data review and verification process a systematic problem or other major issue with the data is identified, then the Parsons project chemist will contact the laboratory's project manager or QA manager. Additional evaluation of the data may be performed including an in-depth review of the raw data to verify accuracy followed by analysis and interpretation of the data in the context of the project objectives and end-use as part of the usability assessment.

The Parsons chemist will review the data verification and validation, then prepare a data quality evaluation report summarizing the findings and discussing the impact on the overall data usability, see Worksheet #37.

36.7 Data Qualifier Conventions

Final data qualifier definitions are summarized in Table 36-1. Parsons will follow the most current EPA guidelines for completing data validation: U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Methods Data Review (EPA January 2017).

Table 36-1 Data Qualifiers and Definitions

Data Qualifier	Definition
U	The analyte was analyzed but was not detected above the level of the reported sample quantitation limit.
J	The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
J+	The result is an estimated quantity, but the result may be biased high.
J-	The result is an estimated quantity, but the result may be biased low.
UJ	The analyte was analyzed but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
R	The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.

Worksheet #37—Data Usability Assessment

The data usability assessment is an evaluation based on the results of data verification and validation in the context of the overall project decisions or objectives. The assessment determines whether project execution and resulting data meet the project DQOs. Both the sampling and analytical activities must be considered, with the ultimate goal of assessing whether the final, qualified results support the decisions to be made with the data.

The following subsections summarize the processes to determine whether the collected data are of the right type, quality, and quantity to support the environmental decision making for the project, and describe how data quality issues will be addressed and how limitations of the use of the data will be handled.

37.1 Summary of Usability Assessment Processes

It is the responsibility of the Parsons project chemist and the laboratory to ensure that the data meet the detection limits and laboratory QC limits listed in this QAPP. During the data verification assessment, nonconformances are documented and data are qualified for use in decision making. The data are determined to be usable by the project chemist based on the requirements of this QAPP. Data gaps will be present if a sample is not collected, a sample is not analyzed for the requested parameters, or the data are determined to be unusable. The need for further investigation will be determined on a case-by- case basis. All data are usable as qualified by the data validator, with the exception of rejected data.

Estimated and/or biased results are usable. Outliers, if present, can be addressed on a case-by-case basis. There is no generic formula for determining whether a result is an outlier. Potential outliers will be referred to a statistician and senior consultant, who will determine which formulas are appropriate for classifying data points in a statistically appropriate and defendable manner.

37.2 Evaluation Procedures to Assess Project-specific Overall Measurement Error

In-depth assessment occurs during the data verification process. The verification will assess conformance with the requirements of the methods, SOPs, and objectives of this QAPP. The findings of the data verification process will generate qualifiers applied to the data considered in context to assess overall usability of the data.

37.3 Personnel Responsible for Performing Usability Assessment

- Randy Palachek, Project Manager, Parsons
- Sandra de las Fuentes, Project Chemist, Parsons
- Andrew Hands, Data Manager, Parsons
- Mike O'Brien, Construction Manager, Parsons

37.4 Usability Assessment Documentation

The data verification report will identify precision and accuracy exceedances with respect to the laboratory performance for each batch of samples, as well as comparability of field duplicates. All the results will be assembled and statistically reported for an overall quality assessment provided in the final data evaluation summary report. Discussion will cover

precision, accuracy, representativeness, comparability, and completeness defined in the following subsections.

The assessment process will measure precision, accuracy/bias, sensitivity, representativeness, comparability, and completeness, using the formulas listed below and the criteria included in Worksheets 12.

Precision - Precision is the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. For this project, the data from LCS/LCSD and MS/MSD analyses will be evaluated. The relative percent difference (RPD) (absolute value) will be calculated for each pair of MS/MSD analyses using the following equation:

$$\%RPD = \left| \frac{S-D}{(S+D)/2} \right| * 100$$

Where:

S = First sample value (original value)

D = Second sample value (duplicate value)

RPDs will be calculated for the LCS/LCSD and MS/MSD pairs. The results of the laboratory precision analysis and conclusions/limitations will be summarized in the Data Usability Assessment.

Accuracy/bias - Accuracy/bias is the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components, which result from sampling and analytical operations. For this project the data from LCSs, MS/MSDs, and blanks will be analyzed and evaluated. The percent recovery (%R) of LCSs and MSs will be calculated using the following equation:

$$\%R = \left(\frac{A-B}{C} \right) * 100$$

Where:

A = The analyte concentration determined experimentally from the spiked sample;

B = The background level determined by a separate analysis of the unspiked sample; and

C = The amount of the spike added.

The results for method blanks, instrument blanks, laboratory control samples, and matrix spike samples will be evaluated for accuracy/bias. Results that exceed the criteria on Worksheets #12.1 through 12.10 and 28.1 through 28.7 will be discussed in the Data Usability Assessment. Any data limitations based on the exceedances will be summarized in the conclusions.

Representativeness - Representativeness is a qualitative parameter that evaluates the degree to which sample data accurately and precisely represent a characteristic of a

population, a sampling point, or an environmental condition. Investigation samples and duplicates will be collected in a manner to ensure that the sample is representative of site conditions. The laboratory SOPs describe how sample aliquots are prepared so that sample analysis is representative of the whole sample or the extract remains representative of environmental conditions. The sampling plan was designed to collect samples that are representative of environmental conditions. The field and QC samples data will be evaluated for representativeness. Sample holding times and blank contamination will be evaluated because samples with expired holding times or blank contaminations may not be not representative. The conclusions and any data limitations will be summarized in the Data Usability Assessment.

Comparability – Comparability is a qualitative parameter that expresses the confidence with which one data set can be compared to another, and is a prime concern when current data are being integrated with historical data. However, only data with known quality, i.e., precision and bias, can be reliably compared. Comparability of data is maximized through the use of SOPs (field and laboratory) and analytical methods that conform to the appropriate method. Elements necessary for comparability of data include use of standard methodologies, use of standard reporting units, report formats, and the use of standard measures of accuracy and precision for QC samples. The analytical methods chosen are comparable to the methods used to analyze samples from previous investigations. Data from the studies included in Worksheet #13 will be evaluated for comparability with the data collected from this evaluation. The results of this analysis will be included in the Data Usability Assessment.

Sensitivity - Sensitivity is the capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest (NELAC, 1999). For this project, existing method detection limit studies will be evaluated and initial calibration low standards at the quantitation limit will be analyzed. Sensitivity will be evaluated by comparing the results of the initial calibration low standards to the criteria on Worksheets 12.1 through 12.10 and the quantitation limits on Worksheets 15.1 through 15.9. Results that exceed QAPP criteria will be discussed in the Data Usability Assessment. Any data limitations based on the exceedances will be summarized in the conclusions.

Completeness - The data completeness of laboratory analytical results will be calculated based on the number of analytical results of individual target analytes and matrices required for decision making. Completeness is calculated using the following equation:

$$Completeness = \frac{Validated\ and\ Acceptable\ Data\ Obtained}{Total\ Data\ Planned} * 100$$

The laboratory analytical results will be assessed for compliance with the amount of data required for decision making. Completeness will be calculated as a measure of the project-specific data that are valid, based on the data validation. Data that are qualified as estimated will not be counted against the completeness goal because they are considered usable. The completeness goal for this project is 90%.

Describe the evaluation procedure used to access overall measurement error associated with the project: Data verification will be performed on 100% of the data. Data usability will be evaluated in accordance with the methods described in this section primarily to ensure that results are received for all samples and that holding times, and percent recoveries (as described above) are within acceptable limits.

References

CH2M HILL (CH2M). 2017. Quality Assurance Project Plan, USS Lead Site, Zone 3, East Chicago, Indiana, WA No. 226-RARA·053J, Contract No. EP-S5-06-01. April.

SulTRAC. 2017. Draft Remedial Design for Zone 3 Properties, U.S. Smelter and Lead Residential Area Superfund Site, East Chicago, Lake County, Indiana. February.

SulTRAC. 2018. Final Remedial Design for 100 Zone 2 Properties, U.S. Smelter and Lead Residential Area Superfund Site, East Chicago, Lake County, Indiana. January.

Tetra Tech, Inc. 2017. Final Sampling and Analysis Plan for Zone 2 and 3 Residential Inspection. USS Lead Site. March.

U.S. Environmental Protection Agency (EPA). 1995. "Good Laboratory Practices" in Principles and Guidance to Regulations for Ensuring Data Integrity in Automated Laboratory Operations.

U.S. Environmental Protection Agency (EPA). 2003. Superfund Lead-Contaminated Residential Sites Handbook. OSWER #9285.7-50. September.

U.S. Environmental Protection Agency (EPA). 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process. EPA QA/G-4. February.

U.S. Environmental Protection Agency (EPA). 2008. *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods.* SW-846, 3rd Edition, Update III, Section 1.

U.S. Environmental Protection Agency (EPA). 2009. Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use, EPA OSWER No. 920.1-85, EPA 540-R-08-005. January 13.

U.S. Environmental Protection Agency (EPA). 2012. Record of Decision, US Smelter and Lead Refinery, Inc. Superfund Site, Operable Unit 1, East Chicago, Indiana. November.

U.S. Environmental Protection Agency (EPA). 2012. Uniform Federal Policy for Quality Assurance Project Plans- Optimized UFP-QAPP Worksheets.

U.S. Environmental Protection Agency (EPA). 2016a. *National Functional Guidelines for Inorganic Superfund Methods Data Review*. EPA-540-R-2016-001. September.

U.S. Environmental Protection Agency (EPA). 2016b. *National Functional Guidelines for Superfund Organic Methods Data Review*. EPA-540-R-2016-002. September.

APPENDIX A
LAB CERTIFICATIONS AND SOPS

This page intentionally left blank

ALS-HOLLAND

STATE OF ILLINOIS

ENVIRONMENTAL PROTECTION AGENCY
NELAP - RECOGNIZED
ENVIRONMENTAL LABORATORY ACCREDITATION

is hereby granted to

ALS ENVIRONMENTAL - MI

3352 128TH AVENUE

HOLLAND, MI 49424-9263

NELAP ACCREDITED

ACCREDITATION NUMBER #200076

According to the Illinois Administrative Code, Title 35, Subtitle A, Chapter II, Part 186, ACCREDITATION OF LABORATORIES FOR DRINKING WATER, WASTEWATER AND HAZARDOUS WASTES ANALYSIS, the State of Illinois formally recognizes that this laboratory is technically competent to perform the environmental analyses listed on the scope of accreditation detailed below.

The laboratory agrees to perform all analyses listed on this scope of accreditation according to the Part 186 requirements and acknowledges that continued accreditation is dependent on successful ongoing compliance with the applicable requirements of Part 186. Please contact the Illinois EPA Environmental Laboratory Accreditation Program (IL ELAP) to verify the laboratory's scope of accreditation and accreditation status. Accreditation by the State of Illinois is not an endorsement or a guarantee of validity of the data generated by the laboratory.

Primary Accrediting Authority: MN Department of Health, ELAP

Celeste M. Crowley
Acting Manager
Environmental Laboratory Accreditation Program

John South
Accreditation Officer
Environmental Laboratory Accreditation Program

Certificate No.: 004316
Expiration Date: 12/31/2018
Issued On: 02/16/2018

ALS Standard Operating Procedure

DOCUMENT TITLE:	BALANCE USE AND MAINTENANCE
REFERENCED METHOD:	N/A
SOP ID:	HN-EQ-001
REV. NUMBER:	R06
EFFECTIVE DATE:	08/31/2016

BALANCE USE AND MAINTENANCE

SOPID:	HN-EQ-001	Rev. Number:	R06	Effective Date:	08/31/2016

Approved By: _____ Date: 8/4/16
Operations Manager

Approved By: _____ Date: 8/3/16
QA Manager

Approved By: _____ Date: 8/4/16
Laboratory Director

Archival Date: _____ Doc Control ID#: _____ Editor: _____

PROCEDURAL REVIEW

SIGNATURES BELOW INDICATE NO PROCEDURAL CHANGES HAVE BEEN MADE TO THE SOP SINCE THE APPROVAL DATE ABOVE. THIS SOP IS VALID FOR 24 ADDITIONAL MONTHS FROM DATE OF THE LAST SIGNATURE UNLESS INACTIVATED OR REPLACED BY SUBSEQUENT REVISIONS.

Signature	Title	Date
Signature	Title	Date
Signature	Title	Date

TABLE OF CONTENTS

BALANCE USE AND MAINTENANCE

1) Scope and Applicability

1.1 This standard operating procedure (SOP) provides guidance for the proper use and care of analytical and top loading balances. Primarily, balances are used to weigh pure chemicals for the preparation of standards and to weigh samples for analysis. Improper use, or abuse, of the analytical balances will cause erroneous results.

2) Summary of Procedure

2.1 Balances must have calibration checks performed each day of use to verify the accuracy of the unit over its expected working range. Balance calibration checks must be performed using ASTM Class "1" certified weights depending on range of use.

2.2 On an annual basis, balances must be serviced and re-certified by a qualified vendor.

2.3 Weights must be re-certified, at a minimum, every three (3) years by a qualified vendor.

3) Definitions

3.1 Balance: A mechanical device used to measure the mass of an object by comparing it to a standard mass. In this SOP, the word "balance" denotes an electronic scale that indicates the equivalent mass of an object.

3.2 Buoyancy: The apparent decrease in the mass and, hence, the weight of an object immersed in a fluid (liquid or gas); equal to the mass of fluid displaced by the object.

3.3 Mass: The ratio of net force acting on a material object to the resultant linear acceleration of the object; an intrinsic property of matter.

3.4 Scale: A mechanical device used to measure the weight of an object by comparing it to a calibrated force, usually by deformation of a spring or beam.

4) Health and Safety Warnings

4.1 None

5) Personnel Qualifications and Responsibilities

5.1 It is the responsibility of each analyst to be familiar with all applicable balance use procedures outlined in this SOP.

6) Procedure

6.1 Take all steps necessary to reduce potential interferences

6.1.1 Vibrations from activities on the bench top where a balance is located will cause errors. These effects should be minimized by the use of heavy balance tables and/or vibration reducing mats.

6.1.2 Wind currents may cause measurement errors. Balances should be located in areas protected from wind currents.

6.1.3 Doors on analytical balances must always be closed while weighing to eliminate errors from drafts.

6.2 Calibrate balances according to the manufacturer instruction.

6.2.1 A qualified external vendor using NIST-traceable masses must verify calibration annually.

6.3 Location and preparation of the balance

6.3.1 The balance must rest on a stable, vibration-free platform. Specially manufactured balance tables provide the best balance platforms. A securely placed laboratory bench is also satisfactory if the bench is used for non-vibratory processes.

6.3.2 The room in which the balance is located must not experience wide and rapid temperature variations. Furthermore, the atmosphere around the balance must be free of drafts and variable humidity.

6.3.3 The balance should not be located in an area where it is likely to be exposed to corrosive fumes.

6.3.4 The balance must have a current external calibration certification issued by a qualified vendor. A dated calibration sticker affixed to the balance should indicate the date of the most current calibration performed by an external, qualified vendor. External calibration and balance cleaning must be performed annually.

6.3.5 The electronic and physical components of the balance must be in thermal equilibrium. Ensure that the balance has had sufficient time to warm up properly.

6.3.6 The balance pan must be clean and dry. Examine the pan carefully to ensure that it is free of particles, fibers, and liquid.

6.3.7 The balance must be level. Examine the bubble in the balance spirit level to determine whether the balance is appropriately positioned.

6.3.8 The balance must be zeroed prior to making a measurement. Ensure that the balance doors are closed. The balance display should indicate zero mass. If it indicates a stable non-zero mass, tare the balance.

6.3.9 The balance must be operated at all times according to the procedures specified in this SOP.

6.4 Preparation of the Object to be weighed

6.4.1 An object placed on the balance pan must not leave any residue when removed from the pan. The exterior surface of a weighed object must be free of loose particles, liquid, grease, etc. Powdered or granular solid chemicals and liquids must be placed in a container for weighing.

6.4.2 The object to be weighed must be at the same temperature as the air within the balance case (room temperature). A warm object generates rising air currents that lift the object, decreasing its apparent mass. Conversely, cold objects show erroneously large masses.

6.4.3 The object to be weighed must have a stable mass. Many chemicals are efflorescent or deliquescent, releasing or absorbing moisture to the atmosphere depending on the local temperature and humidity. Strong bases absorb carbon dioxide from the air. Liquids may evaporate. Substances having these properties must be weighed in airtight weighing bottles.

6.4.4 The object being weighed must not support a static electrical charge. Dry plastic weighing boats and glass containers readily obtain and retain large static charges. These objects may be attracted or repelled by a static charge on the glass balance case, resulting in an erroneous mass. If possible, weigh

chemicals in a metal dish, such as an aluminum pan. If this is not possible, use the smallest practicable glass or plastic container. The use of static strips is recommended to minimize error resulting from static charge.

6.4.5 The object being weighed must not chemically attack (corrode) the balance. NEVER PLACE CHEMICALS DIRECTLY ON THE BALANCE PAN. Do not weigh open containers of concentrated acids that produce corrosive vapors. Seal such compounds in an airtight container before weighing.

6.4.6 The object being weighed must have a mass less than the capacity of the balance. NOTE: An excessively heavy object may damage the balance.

6.4.7 When weighing out a required mass of a chemical, pour the estimated required quantity of the chemical from its original container into a second clean container, and transfer the chemical from the second container to the container on the balance pan with a spatula. Always remove a chemical from its original container; avoid putting anything into the original container. Inserting a spatula into an original chemical container can lead to primary source contamination.

6.5 Weighing an Object

6.5.1 Carry an object to be weighed with clean tongs or forceps. Do not hold the object with the fingers. Oil or dirt could be transferred from the fingers to the object, giving an erroneously high mass indication. Touching the object with clean fingers raises the temperature of the object, resulting in an erroneously low mass indication.

6.5.2 Center the object to be weighed on the balance pan. An off-center object may give an erroneous mass indication.

6.5.3 Close the balance case.

6.5.4 Allow the mass indication to reach a stable value. In general, the indicated mass value should be constant for at least 10 seconds. If a constant mass value cannot be obtained, the object or chemical being weighed may be reacting with the atmosphere, or the container may be leaking an electrostatic charge.

6.5.5 If a required mass of a chemical is being weighed into a container on the balance pan, the container mass may be tared to zero, or the mass of the container may be recorded and later subtracted from the total mass of the container and chemical. The latter method is preferable since it obviates the possibility that someone else may re-tare the balance while the original user is temporarily away.

6.5.6 When transferring a chemical or sample into a container on the balance pan, be extremely careful not to spill any of the material on the balance pan or in the balance case.

6.5.7 To minimize erroneous notebook entries, record the object mass in the designated logbook while it is being displayed on the balance, alternatively, electronically record the indicated weight if the balance has this capability.

6.6 After Weighing

6.6.1 Immediately remove the weighed object from the balance pan. This prevents permanent flexure of the balance beam and is a courtesy to other laboratory personnel who may need to use the balance.

6.6.2 Carefully inspect the balance case. If necessary, immediately clean up any spilled material.

6.6.3 Close the balance case doors.

7) Equipment and Supplies

7.1 Tongs or forceps

7.2 Standard masses (ASTM Class "1")

7.3 Top Loading Balances, capable of weighing to nearest 0.01 g.

7.3.1 OHAUS TS 400S, Scout Pro or equivalent
7.3.2 Sartorius M-Power or equivalent
7.3.3 Mettler PE 3600 or equivalent

7.4 Analytical Balances, capable of weighing to nearest 0.1 mg or 1.0 mg.

7.4.1 Sartorius ED 124S or equivalent
7.4.2 Mettler AE 50 or equivalent

8) Quality Assurance and Quality Control

8.1 When performing a weight measurement, record the identity of the object or material being weighed and the indicated mass of the object or material.

8.2 Each balance must have its own controlled logbook for recording daily balance calibration checks. Record the information listed below at a minimum in the logbook for each balance calibration:

8.2.1 Balance type and Serial #
8.2.2 Class "1" weight set
8.2.3 Date of Calibration Check
8.2.4 Operator
8.2.5 Nominal Mass
8.2.6 Measured Mass
8.2.7 Corrective Action (if applicable)

8.3 Balances must be cleaned and calibrated once a year by a qualified, external vendor using NIST-traceable masses.

8.4 For balances with calibration features, calibration by ALS personnel is to be performed whenever calibration criteria in 8.7 are not met. See Section 6.2.

8.5 The balance calibration must be monitored before use with ASTM Class 1 weights and be documented in the balance calibration logbook.

8.6 The weights must be calibrated every 3 years (or less) by an external qualified source and certificates shall be maintained in Quality Assurance Files.

8.7 Analytical Balance Acceptance Range for Class 1 Weights: +/- 0.1% of certified value.

Analytical Balance (0.0001g)	Acceptance Range for mass used (± 0.1%)	Analytical Balance (0.001g)	Acceptance Range for mass used (± 0.1%)
200g	199.8000 – 200.2000	200 g	199.800 – 200.200
100 g	99.9000 - 100.1000 g	100 g	99.900 - 100.100 g
50.0 g	49.9500 - 50.0500g	50.0 g	49.950 - 50.050 g
20.0 g	19.9800 - 20.0200g	20.0 g	19.980 - 20.020 g
10.0 g	9.9900 - 10.0100g	10.0 g	9.990 - 10.010 g
5.0 g	4.9950 - 5.0050 g	5.0 g	4.995 - 5.005 g
2.0 g	1.9980 - 2.0020 g	2.0 g	1.998 - 2.002 g

Analytical Balance (0.0001g)	Acceptance Range for mass used (± 0.1%)	Analytical Balance (0.001g)	Acceptance Range for mass used (± 0.1%)
1.0 g	0.9990 - 1.0010 g	1.0 g	0.999 - 1.001 g
0.5 g	0.4995 – 0.5005 g	-	-
0.2 g	0.1998 - 0.2002 g	-	-
0.1 g	0.0999 - 0.1001 g	-	-

8.8 Top-Loading Balance acceptance range for Class 1 Weights: +/- 1.0% of certified value.

Top Loading Balance (0.1 g)	Acceptance range for mass used (± 1%)	Top Loading Balance (0.01 g)	Acceptance range for mass used (±1%)
200g	198.0 – 202.0g	200 g	198.00 – 202.00g
100 g	99.0 – 101.0 g	100 g	99.00 – 101.00 g
50.0 g	49.5 – 50.5 g	50.0 g	49.50 – 50.50 g
20.0 g	19.8 – 20.2 g	20.0 g	19.80 – 20.20 g
10.0 g	9.9 - 10.1 g	10.0 g	9.90 - 10.10 g
		5.0 g	4.95 - 5.05 g
		2.0 g	1.98 - 2.02 g
		1.0 g	0.99 - 1.01 g

8.9 If a solid is spilled onto the bottom of the balance case or onto the balance pan, immediately sweep it off the pan and out of the case with a soft paper towel or "camel hair" brush.

8.10 If a liquid is spilled onto the bottom of the balance case or onto the balance pan, immediately absorb as much as possible of the liquid with a paper towel. If the liquid is volatile, leave the balance case open until the liquid has completely evaporated and the vapors have dissipated. If the liquid is not volatile (such as an oil), use a paper towel soaked in a suitable non-corrosive solvent to remove the last traces of the liquid. Leave the balance case open to evaporate and dissipate the solvent.

8.11 Corrective Action for acceptance criteria (Section 8.7 and 8.8) failure:

8.11.1 Document the failure in the logbook,
8.11.2 Recheck the balance zero, re-zero as necessary;
8.11.3 Check balance for any excessive dirt or dust that will bias a result, clean area as necessary;
8.11.4 Evaluate room conditions for excessive drafts or extreme temperature changes (if A/C efficiency is affected, the balance accuracy could also be affected);
8.11.5 Check the balance with another set of standard weights (i.e., ASTM Class 1) and evaluate reproducibility;
8.11.6 Re-calibrate the balance
8.11.7 If any of the above fail to correct the problem;

- Notify the area supervisor, Operations Manager, or QA department so that balance service can be scheduled by a qualified vendor for repairs;
- Place a visible note on the balance so to indicate the balance is **"Out of Service"**.

- Do not use until service is performed to bring the balance back into the operating acceptance range.
- Document MAINTENANCE activities in the appropriate logbook designated for the balance.

9) Summary of Changes

Table 9.1 Summary of Changes

Revision Number	Effective Date	Document Editor	Description of Changes
R05	7/1/13	CES	Formatting
R06	8/31/16	CES	Updated to stipulate ASTM Class "1" weights

10) References and Related Documents

10.1 ASTM E898-00, "Standard Method for Testing Top-Loading, Direct-Reading Laboratory Scales and Balances"

10.2 U.S. Environmental Protection Agency. Handbook for Analytical Quality Control in Water and Wastewater Laboratories. EPA-600/4-79-019.

10.3 ALS Environmental Quality Assurance Manual, Revision (most current)

ALS Standard Operating Procedure

DOCUMENT TITLE:	THERMOMETER CALIBRATION AND TEMPERATURE MONITORING
REFERENCED METHOD:	N/A
SOP ID:	HN-EQ-002
REV. NUMBER:	R10
EFFECTIVE DATE:	08/31/2016

THERMOMETER CALIBRATION AND TEMPERATURE MONITORING

SOPID:	HN-EQ-002	Rev. Number:	R10	Effective Date:	08/31/2016

Approved By: _____ Date: 8/4/16
Operations Manager

Approved By: _____ Date: 8/3/16
QA Manager

Approved By: _____ Date: 8/4/16
Laboratory Director

Archival Date: _____ Doc Control ID#: _____ Editor: _____

PROCEDURAL REVIEW

SIGNATURES BELOW INDICATE NO PROCEDURAL CHANGES HAVE BEEN MADE TO THE SOP SINCE THE APPROVAL DATE ABOVE. THIS SOP IS VALID FOR 24 ADDITIONAL MONTHS FROM DATE OF THE LAST SIGNATURE UNLESS INACTIVATED OR REPLACED BY SUBSEQUENT REVISIONS.

Signature	Title	Date
Signature	Title	Date
Signature	Title	Date

TABLE OF CONTENTS

THERMOMETER CALIBRATION AND TEMPERATURE MONITORING

1) Scope and Applicability

1.1 This SOP provides guidance for calibration verification of thermometers and maintenance of temperature monitoring records for temperature critical equipment.

1.2 Equipment requiring temperature monitoring is monitored daily using calibration verified thermometers.

2) Summary of Procedure

2.1 Working liquid thermometers in the laboratory are checked annually against an NIST reference thermometer. Working electronic thermometers in the laboratory are checked quarterly against a NIST reference thermometer. If the thermometer calibration verification generates a correction factor, it is placed on the label for reference during all uses of the thermometer. Temperature measuring devices cannot have a correction factor exceeding ± 1 ° C when used to monitor laboratory temperature critical equipment (refrigerators, ovens, etc.).

2.2 The NIST traceable thermometer(s) used to perform calibrations checks must be verified every three (3) years minimally by an external NVLAP qualified calibration lab.

2.3 Continued monitoring of temperature critical equipment is performed daily to assure that equipment is maintained in the required temperature range.

3) Definitions

3.1 Correction Factor: An amount of temperature bias assigned to a thermometer at specified temperature when compared against a certified reference thermometer.

3.2 Liquid Thermometer: A mercury or alcohol filled thermometer

3.3 Digital Thermometer: An electronic thermometer

3.4 QA: Quality Assurance

4) Health and Safety Warnings

4.1 Whenever possible, laboratory thermometers should be non-mercuric.

4.2 Lab Safety

4.2.1 Due to various hazards in the laboratory, safety glasses, disposable gloves, and laboratory coats or aprons must be worn when working with unknown samples. In addition, heavy-duty gloves and a face shield are recommended when dealing with toxic, caustic, and/or flammable chemicals.

4.3 Waste Disposal

4.3.1 Procedures for sample disposal are documented in SOP HN-SAF-001, *Waste Disposal Procedures.*

4.3.2 Samples must be disposed according to Federal, State, and local regulations.

4.4 Pollution Prevention

4.4.1 Mercury thermometers must be disposed according to Federal, State, and local regulations.

4.5 Never heat a thermometer beyond its maximum operating temperature, as it may burst, releasing the contents and causing projectile shards of glass.

4.6 Take appropriate caution when working with boiling water.

5) Personnel Qualifications and Responsibilities

5.1 The procedure for thermometer calibration checks must be performed by the QA Department.

5.2 Analytical department members must perform daily equipment temperature checks.

6) Procedure

6.1 Liquid thermometers function properly only when the liquid column is continuous. An inspection of column for a split is necessary to avoid recording an inaccurate reading.

6.2 Liquid Thermometer Inspection

6.2.1 Determine whether the thermometer to be checked is used as a total or partial immersion thermometer prior to beginning the calibration verification procedure.

6.2.2 All liquid thermometers must be inspected for separation of the liquid column and for cracks or other flaws before use. If a flaw is noted, the thermometer must be removed from use.

6.3 If a liquid separation is discovered in a thermometer, attempt to remove the separation.

6.3.1 Try gentle shaking of the thermometer.

6.3.2 If this does not work, utilize a heat gun to bring the thermometer to a temperature sufficient to raise the liquid into the upper reservoir. After the liquid has risen to the reservoir, remove from the heat source and allow cooling. Check to be certain the liquid separation has been removed.

- *Use particular caution, as the thermometer could burst.*

6.4 Thermometer Labeling

6.4.1 All thermometers must be given a unique lab number that is permanently recorded (usually the serial number).

6.4.2 Record the unique lab number in the Thermometer ID database, along with date of initial calibration, expiration date, and recalibration frequency.

6.4.3 The number must be affixed to a string tag indicating the applicable correction factor and expiration date.

6.5 Thermometer Calibration

6.5.1 On an annual (liquid) or quarterly (electronic) basis, the working thermometers will be calibrated against an NIST certified or traceable reference thermometer.

6.5.2 List the thermometer ID for each thermometer calibrated on the Thermometer Calibration Log.

6.5.3 The certified thermometer is either totally immersed or partially immersed, depending upon its design type. (A total immersion requires that the entire thermometer be covered with the liquid used for the calibration. A partial immersion will be scored with a line below the scale to indicate how deep it must be immersed.)

6.5.4 The thermometers must be calibrated by one of the three methods shown below. The method used will depend upon which type of equipment the thermometer is used in. If the thermometer is used in refrigerators or freezers, use calibration with ice water (or similar chilled environment). If the thermometer is used in incubators or equipment near room temperature, use calibration method with room temperature water. If the thermometer is used in ovens, use calibration method with boiling water (or similar heated environment). If it is unknown where the thermometer will be used, use calibration method for room temperature.

- Calibration with ice water: A beaker or other container is filled with crushed ice and DI water. (Alternatively, place thermometers in a chilled unit and allow the temperature to equilibrate.) DI water is added to create a slurry/slush. The reference thermometer is immersed to the proper level and the working thermometer is immersed to the proper level. After 5 minutes, record the reference thermometer reading and the working thermometer reading in the Thermometer Calibration Log. Determine the difference or CF as per section 6.8. Note: If the ice begins to float, remove the excess water.
- Calibration with room temperature water: A beaker or other container is filled with DI water and covered, and placed in an area of relatively stable temperature. Allow the temperature to equilibrate. The reference thermometer is immersed to the proper level and the working thermometer is immersed to the proper level. After 5 minutes, record the reference thermometer reading and the working thermometer reading in the Thermometer Calibration Log. Determine the difference or CF as in section 6.8.
- Calibration Using Boiling Water: A beaker or other container is filled with DI water and brought to a boil on a hot plate. (Alternatively, place the thermometers in a heated oven and allow the temperature to equilibrate.) The reference thermometer is immersed to the proper level and the working thermometer is immersed to the proper level. After 5 minutes, record the reference thermometer reading and the working thermometer reading in the Thermometer Calibration Log. Determine the difference or CF as in section 6.8.

6.6 Acceptance

6.6.1 Working thermometers with a difference of more than 1°C to the reference thermometer must be removed from service and replaced.

6.7 Daily Monitoring

6.7.1 Monitor equipment each day of use (including weekends and holidays).
6.7.2 Refer to Attachment 10.6 for the Equipment Monitoring Responsibility Log
6.7.3 Temperature acceptance must fall within the defined limits of:

- Refrigerator Monitoring Acceptance: <6.0° C
- Freezer Monitoring Acceptance: < -10° C
- TDS Drying Oven Acceptance: 180° ± 2°C
- TSS Drying Oven Acceptance: 104° ± 1°C
- BOD Incubator Acceptance: 20° ± 1°C

6.7.4 If a monitoring log is being utilized, record the actual temperature "as read". Compare the temperature as read to the header information which documents the correction factor and acceptable temperature range. For example, should a refrigerator monitoring device have a CF = +0.5 °C, the refrigerator acceptance range is evaluated at <6.5° C.

6.7.5 If no monitoring logs are present, record the actual temperature "as read" and the corrected temperature utilizing the device's correction factor. This applies to all analytical work at the bench level and temperatures taken upon sample receipt.

6.8 Calculation of the Correction Factor (CF):

6.8.1 Correction Factor (or CF): The CF must be within ± 1 ° C of N to be within tolerance.

$$CF = N - T$$

Where:
CF = the correction factor
N = the temperature reading of the NIST reference thermometer
T = the reading of the working thermometer being calibrated

7) Equipment and Supplies

7.1 NIST certified or traceable reference thermometers. The temperature range for most applications includes -10°C to 200°C to cover the temperature ranges commonly required of the laboratory equipment.

7.2 Ice water bath

7.3 Hot plate

7.4 Beakers

7.5 Heat Gun

8) Quality Assurance and Quality Control

8.1 Calibration of the NIST reference thermometer is performed by an external NVLAP approved calibration lab.

8.2 All thermometers utilized in microbiological measurements must be replaced annually.

8.3 All methods requiring temperature-controlled conditions for storage, incubator drying or for any procedure must be documented with a temperature log.

8.4 The temperature logs must document equipment ID, thermometer ID, and acceptance limits.

8.5 All record books for thermometer calibration and identification shall be maintained by the QA Department.

8.6 Certificate of Calibration must be maintained for the primary NIST reference thermometer.

8.7 NIST reference thermometers must have delineations equivalent to those of the equipment thermometer being calibrated.

8.8 An approved out-side vendor must certify NIST reference thermometers every 3 years or less.

9) Summary of Changes

Table 9.1 Summary of Changes

Revision Number	Effective Date	Document Editor	Description of Changes
R08	7/1/13	CES	Formatting/Removal of TCLP Log
R09	10/1/14	CES	Addition of language requiring corrected and un-corrected readings, as well as inclusion of the Monitoring Responsibility Log.
R10	08/31/16	CES	Updated document review criteria.
R10	08/31/16	CES	Updated refrigerator monitoring criteria to be <6° C

10) References and Related Documents

10.1 *Standard Methods for the Examination of Water and Wastewater*, 19th Edition, 1992, Section 9020B-2.a, Laboratory Equipment and Instrumentation.

10.2 ALS Environmental Quality Assurance Manual, Revision (most current)

10.3 Manual for the Certification of Laboratories Analyzing Drinking Water, EPA 815-R-05-004, January 2005

10.4 TNI Standard, Quality Systems, Volume 1/Module 2/Section 5.5.13.1, (Adopted September 9, 2009 & Implemented July 1, 2011)

10.5 Thermometer Calibration Log

10.6 Equipment Monitoring Responsibility Log